

## CALCULATORS



### Creative Green Tools

A free set of unique carbon calculators developed by Julie's Bicycle specifically for the creative industries.



### GCC's Carbon calculator

The free online tool is designed to help estimate the carbon footprint of your business based on metrics common to most art galleries in today's international art world. It aims to be as easy to use as possible and provide a quick breakdown of the main sources of greenhouse gas emissions.



### A Carbon Footprint Calculator

A free to use calculator useful for travel emissions calculations.



### Carbon footprint of materials used in museums and galleries

Comparison of the carbon footprint between products allows the user to select materials with less kg CO<sub>2</sub>eq, thus making educated choices, truly lowering the environmental impact of their actions.



### Paper life cycle assessment

The Paper Calculator is a publicly available web-based tool which allows users to calculate and compare the estimated environmental impacts of different paper choices using a science-based methodology grounded in life cycle assessment (LCA).



### CO<sub>2</sub> calculator for digital media

Measuring and counteracting the carbon footprint of your adverts.



### B Impact Assessment

Measure and manage your organisation's social and environmental impact.

## RESOURCES



### United Nations Climate Neutral Now

Join this initiative to achieve a climate-neutral world by 2050, as enshrined in the Paris Agreement. As an organisation you can take part by signing the Climate Neutral Now Pledge, following the three steps (Measure, Reduce, Contribute), and reporting on its actions and achievements annually.



### Inventory of carbon and energy (ICE) database

A free online resource with information about the embodied carbon of more than 200 materials.



### AIA Framework for Design Excellence

The framework is made up of 10 measures for a sustainably built environment.



### 2030 Palette

A database of sustainable design strategies and resources for architects and urban planners.



### Experimental materials database

Future materials bank that supports and promotes the transition towards a more sustainable artistic practice.



### Beacon

An open-source Revit plug-in for structural engineers that generates a data visualisation of a project's embodied carbon.



### Globechain Reuse Marketplace for Business

The leading ESG data reuse marketplace connecting enterprises with non-profits, small businesses and people to redistribute unneeded items.



### Evidenca certifikatov ekološkega kmetovanja (Register of organic farming certificates)

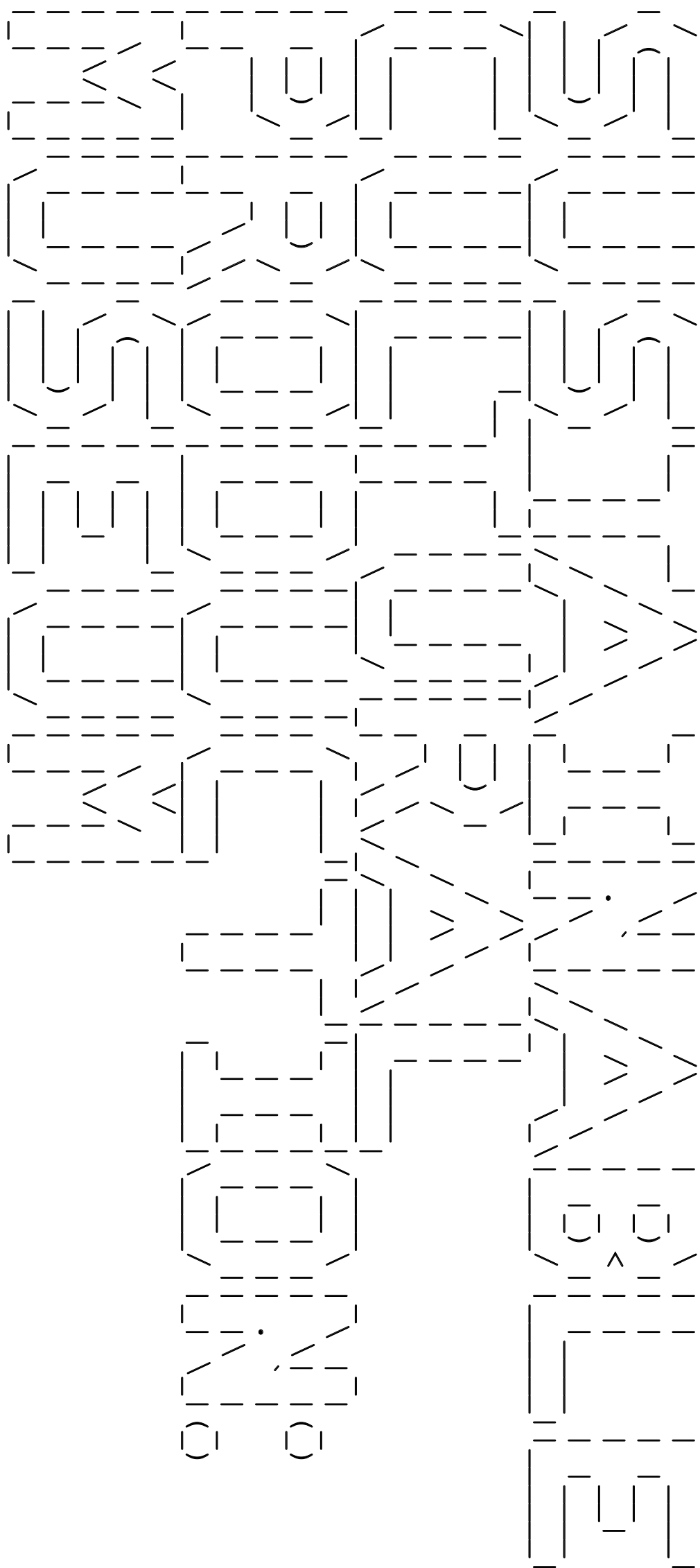
In Slovene only.

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## CONTENTS

1 WHO ARE THESE GUIDELINES FOR?	[P5]
2 FIRST STEPS	[P5]
3 MUSEUM: UNDERSTANDING THE IMPACTS OF CLIMATE CHANGE	[P6]
4 EXHIBITION AND EXHIBITION DESIGN	[P17]
5 GRAPHIC DESIGN - PRINT	[P22]
6 DIGITAL COMMUNICATION & DESIGN	[P29]
REFERENCES	[P30]
CALCULATORS AND RESOURCES	[P32]

“Museums assume an active and indispensable role in society. They safeguard our future generations’ engagement in cultural heritage. Collecting, conserving, researching, and educating are important tasks in the work of museums. At the same time, they are actors themselves, places that contribute to a socially, ecologically, and culturally conscious society by incorporating the future of our life worlds.”

— Jeannette Stoschek, Provisional Director of the Museum der bildenden Künste Leipzig (Beck-Mannagetta 2020, 10)

In 2015, the Sustainable Development Goals and the Paris Agreement (a legally binding international treaty on climate change) were adopted. The nature of this global challenge requires a collective response across all sectors and scales. It is essential that as well as talking about environmental impact, every organisation (and individuals) also analyses its own actions and commits to being environmentally responsible. Museums can play a pivotal role in this because, as the IPCC report *Climate Change 2022: Mitigation of Climate Change* notes, this can broaden the social science perspective. The involvement of new actors and perspectives is important in two ways: “(i) provides more options for climate mitigation; and (ii) helps to identify and address important social and cultural barriers and opportunities to socioeconomic, technological, and institutional change (Skea 2022, TS 99).”

In addition to the outstanding educational and social role of museums, the implications of each exhibition production should not be overlooked. We are all well aware of the waste and impact associated with cultural events and temporary exhibitions and it is clear that we need to put sustainable production (and beyond) at the core of the 27<sup>th</sup> Biennial of Design (BIO27) and future editions of the biennale making marked changes to the way we work and leading by example to reduce environmental impact.

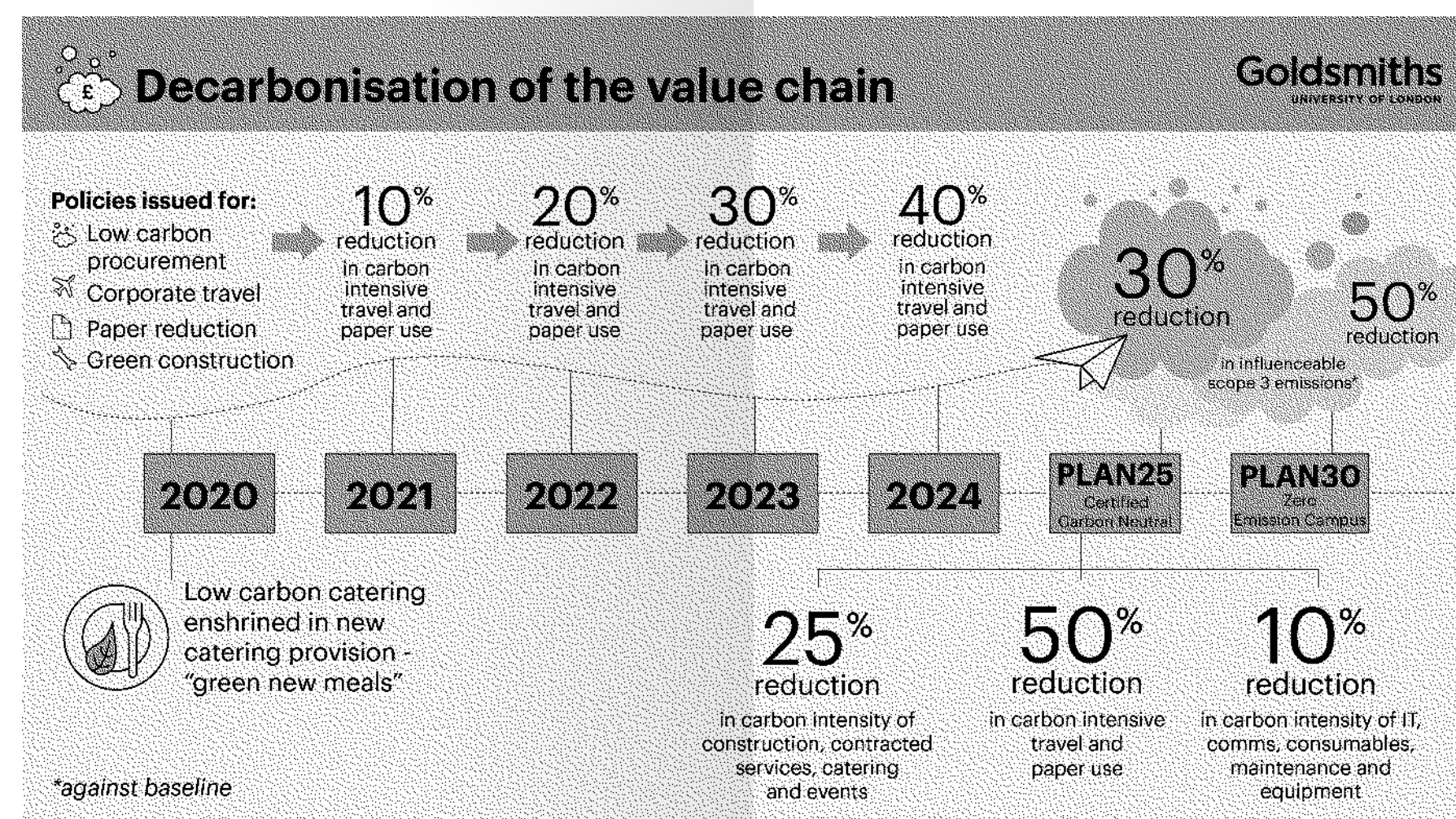
The objective of this commission is using the possibility of the biennale to interrogate its practices and future. We want to gain a deeper understanding of the environmental and social impact of BIO27 and how we can make a positive change. Based on the insights, it will be possible to design a roadmap enabling the BIO and Museum of Architecture and Design (MAO) teams to reduce emissions and set decarbonisation targets going forward as well as demonstrating and communicating innovative approaches to sustainable cultural production. It is important to stress that sustainability goes beyond environment and carbon neutrality and fits into the larger picture, namely the ‘Triple Bottom Line’ of People, Planet and Prosperity (University of Wisconsin 2020).

We also strongly believe in vernacular knowledge of heterogeneous environments held by museum staff, their professional collaborators and visitors. This guide stands on the shoulders of many. It is also built on community feedback and is open source. We encourage all to use it and own the knowledge. Your feedback or better yet content contribution is very welcome.

What follows is a set of best practice guidelines in order to show the way: How can museums respond to the climate emergency.

**Case Study 1  
GOLDSMITHS PLAN 2025**

In August 2019, Goldsmiths, University of London declared a climate emergency and committed to becoming a certified carbon-neutral organisation by 2025 and a zero-emissions campus by 2030. To put these goals into action, they have developed a detailed, step-by-step action plan that sets out all the necessary measures to reduce their carbon emissions. Some key goals from the action plan are: 50% reduction in carbon-intensive travel, 50% reduction in single-use plastics, 90% campus recycling rate, and 100% energy-efficient LED lighting, all by 2025. For example, they have already switched to a 100% renewable energy supplier, removed beef from campus menus, and started divesting from fossil fuels. Each year, they track and analyse their progress against the targets set in the plan.



Goldsmiths PLAN25 becoming carbon neutral: Decarbonisation of the value chain  
Source: Goldsmiths 2019

**1 WHO ARE THESE GUIDELINES FOR?**

The intended audience for these Guidelines is any individual or organisation that creates, defines, publishes, produces, distributes and/or uses cultural production within a museum (or gallery) environment. This includes, but is not limited to:

- Museum staff
- Communication officers
- Publishers
- Designers and architects
- Museum visitors
- Policy makers

Recommendations are statements designed to help end-users make informed decisions on whether, when and how to undertake specific actions such as how to reduce carbon emissions, organise administrative operations efficiency, build the community with outreach and education, and how to ensure sustainable exhibition production.

**2 FIRST STEPS**

To achieve positive change, you will first have to commit to the cause; secondly, you will need to understand the current situation, and only after the first two stages will you be able to start improving.

**Start building a sustainable organisation by taking the following steps:**

1. Declare a climate emergency and commit to become a certified carbon neutral organisation by 2050 the latest. Set an interim target to achieve in the next decade, which reflects maximum effort towards or beyond a fair share of the 50% global reduction in CO<sub>2</sub> by 2030 identified in the IPCC Special Report on *Global Warming of 1.5C* (IPCC 2018).
2. After declaration, start monitoring your annual carbon emissions and establish a baseline year.
3. Prepare your Climate Pledge<sup>1</sup> within 12 months of joining and explain what actions will be taken toward achieving both interim and longer-term pledges, especially in the short-to-medium term.
4. Establish the organisational boundary, i.e. controllable emissions. For instance, Goldsmiths University of London has established 3 different scopes in emissions: controllable, influenceable, and non-influenceable (Goldsmiths 2020).<sup>[CS1]</sup>
  - Controllable emissions are emissions where your organisation has direct control over both the carbon intensity and volume of the activity. For instance:
    - direct energy consumption,
    - transport and travel,
    - catering and events,
    - exhibition design,
    - printing, paper and educational materials.
  - Influenceable emissions are emissions related to the physical procurement of goods, assets and services. The organisation can and should work to influence suppliers to decarbonise their activities. Even though the organisation has no direct control over the carbon intensity of suppliers’ activity, they can influence the situation by preparing sustainability criteria for the selection of participating bidders.
  - Non influenceable emissions are emissions related to financial activities, such as insurances, commissions, compensations and legal fees.
5. Take immediate action toward achieving (net) zero, consistent with delivering interim targets specified.
6. Commit to publicly report both progress against interim and long-term targets, as well as the actions being taken, at least annually.

<sup>1</sup> Write up an Ecological Manifesto and add key clauses into contracts that mirror these new values. Examples of good practice: United Nations Climate Neutral Now (2015), Birmingham Museums – Our Climate Pledge (2021); Natural History Museum – Environmental Policy (2020); Victoria & Albert Museum – Net Zero Emissions Target for 2035 (Kendall Adams 2021).

**3 MUSEUM: UNDERSTANDING THE IMPACTS OF CLIMATE CHANGE**

The Museum’s first responsibility is to reduce the carbon emissions from their museums and historic properties, and this is where you can make the quickest impact. Early adaptation can save time, and money.

It is also important to avoid arbitrary divisions. As defined by the authors of the *Beyond Net Zero* guide: “When looking to create value or act ethically, there is a tendency to differentiate between environmental and social approaches. The two are intrinsically linked and the false dichotomy hinders our capacity to think systemically” (Design Council 2021, 15). However, it is important to remember that environmental and social challenges are not static, but need to be seen in a broader context.

Understanding the broader context of sustainable vernacularity:

- To understand the sustainability context of your activities you need to reconsider the following relationships: economic, environmental, human rights, and other societal challenges at the local, regional, national, (and – if applicable – global) levels related to your organisation’s sectors and the geographic location of your activities (e.g. climate change, water stress, biodiversity loss, gender equality, social equity, poverty, political voice).
- Go beyond CO<sub>2</sub> emissions, consider the wider ecological footprint.
- Enable and promote knowledge commons by opening up access to expertise, data, and ideas.
- Learn from indigenous and innovative peoples to come up with regenerative solutions. Collect, document, and conserve in ways that involve communities of interest, and generate ingenious solutions (McKenzie 2020).
- Support local self-sufficiency, acknowledging the basic importance of food, water, energy, and shelter in people’s education and community activism.
- Identify and explore the local ecosystem to develop regenerative strategies (Furlong 2018). A simple tool: asking “How does nature do it?” and then translating the natural principles into technical solutions (DEAL 2020).
- Promote ecologically innovative and traditional materials/designs, re-use, and sharing of products by supporting eco-enterprises.
- Use, co-develop, support and promote regenerative and distributive design practice (Raworth 2018).
- In relation to your activities (and all of the above), reconsider the organisation’s purpose, value or mission statements, business model, and strategies.

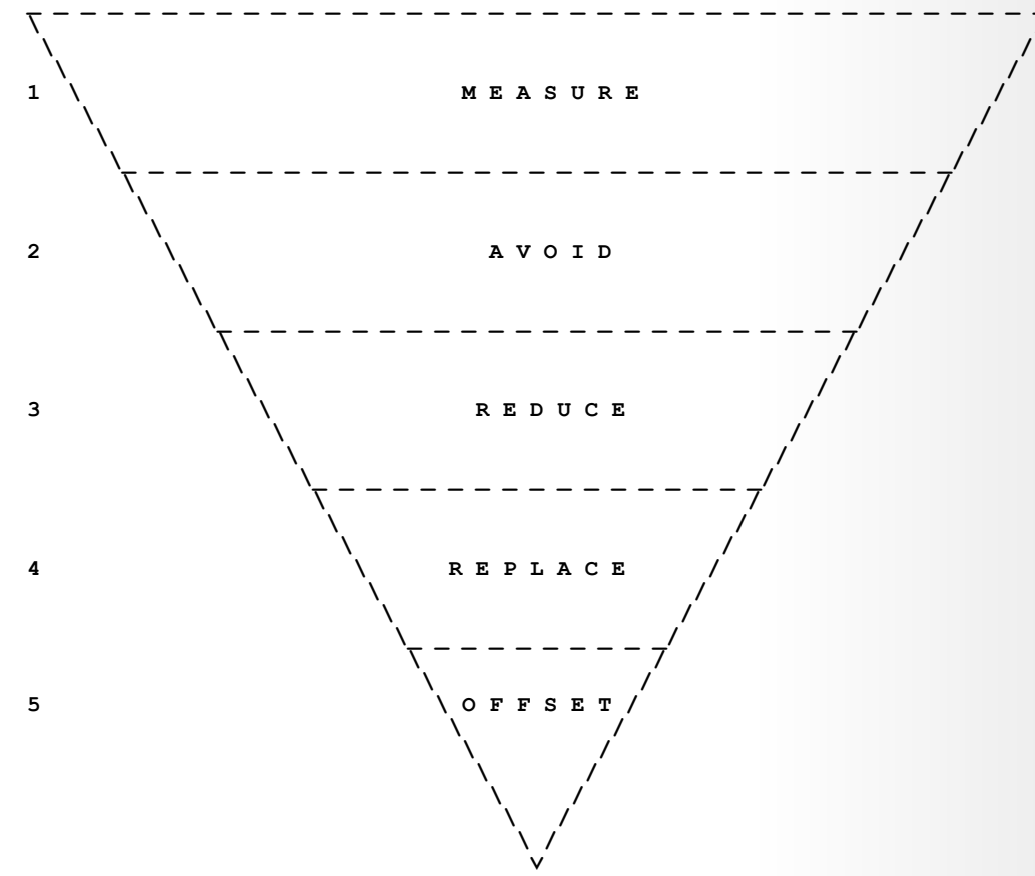
For museums the main areas of emissions are (Smith 2021):

- Energy use for buildings/office running
- Collection management, storage and care, including freight
- Staff/volunteer travel (business and commuting)
- Estates management (cleaning and waste management)
- Visitor travel
- Café and retail operations

**How to start?**

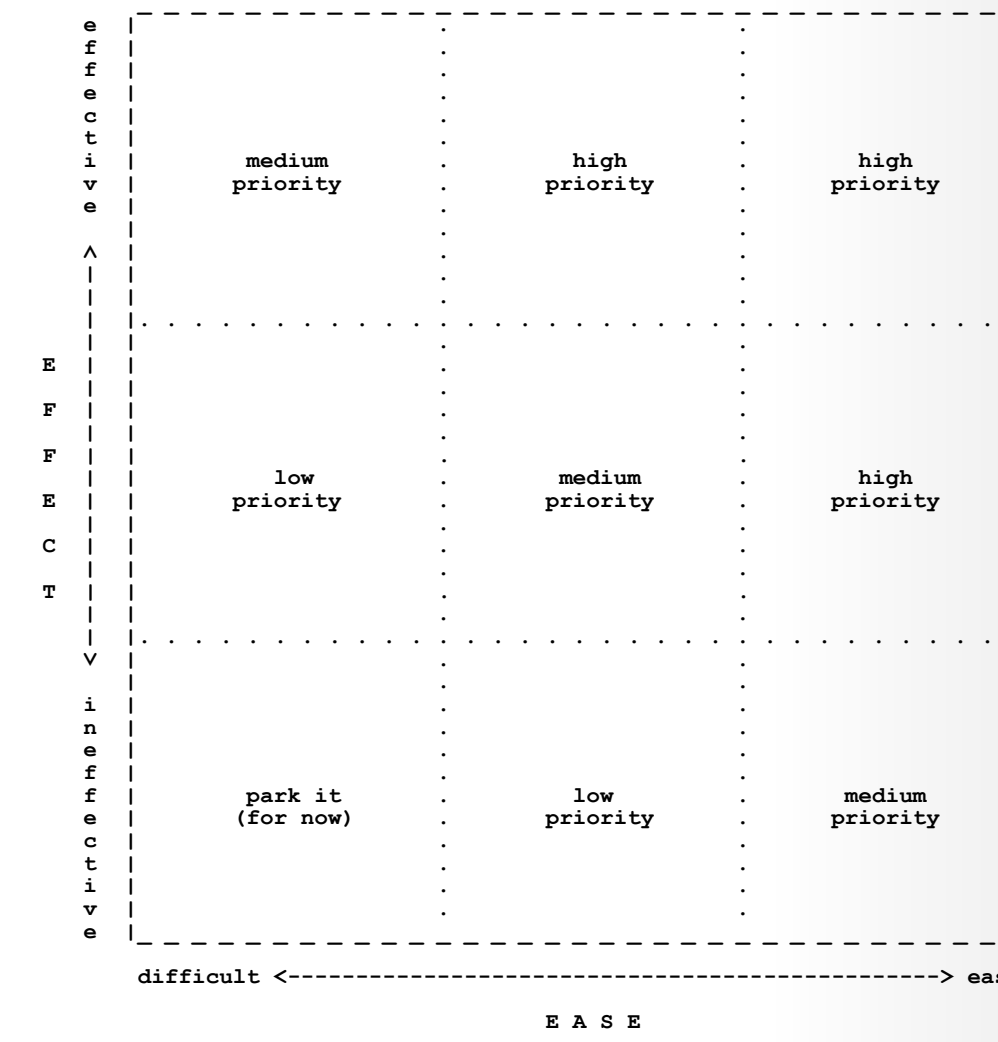
- Analyse and identify opportunities for your business model. What are your biggest pollutants? Identifying the major impacts allows you to find opportunities for bigger change.
- Get the priorities right: <sup>[161]</sup>
  1. Start by measuring your current footprint to understand where you are and where improvement can be made. (E.g. *how much paper does your institution use for the printing of internal communication documents?*)
  2. The most effective way to prevent the environmental impact is by avoiding unnecessary consumption and activities altogether. (E.g. *can we avoid printing out working documents and only print the essentials?*)
  3. The next best way of minimising the impact is by reducing. (E.g. *can we reduce the need for paper by rethinking internal communication?*)

**Infographic 1  
HIERARCHY DIAGRAM**



Source: Putting a Price on Carbon (Julie’s Bicycle 2021)

**Infographic 2  
EFFECT / EASE DIAGRAM**



Source: BIO27 Supervernaculars, Julie’s Bicycle (26 January 2022)

4. Where reduction is not possible or not effective enough, replacement should be considered. (E.g. *can we use recycled paper instead of virgin paper?*)
  5. The last resort in your strategy should be offsetting your footprint. (E.g. *can we substitute the use of virgin materials by planting trees?*) Please note that offsetting is a method accounting for emissions you absolutely can’t avoid using existing technology or solutions and not a reliable means to reduce emissions tonne for tonne or an excuse to carry on with business as usual.
- Set targets based on how effective and easy to implement they are. Possible examples of immediate actions (CIMAM 2021, 4): <sup>[162]</sup>
    - Extend the duration of exhibitions to over 3 and a half months or even longer.
    - Greater focus on local artists and works from the collection.
    - Reusable exhibition furniture, such as display cases and frames, reusing walls from previous exhibitions, developing modular temporary walls, and reusing wooden flooring employed for protection during the installation.
    - List the stored items, create guidelines for exhibition designers regarding which materials could be used, non-toxic, recyclable or reusable, etc. (See the following sections of this guide.)
    - Offer workshops and training programmes to help foster awareness of the need to protect our environment.
  - Obtain certificates to rate the environmental sustainability performance of your programmes, operations, and building management.
  - Apply for grants that support environmental operational changes and the production of environment-related programmes (CIMAM 2021, 7).

**Practical steps to reduce the main areas of emissions**

First things first: involve all museum departments in all stages of the planning and execution of the sustainable transition (CIMAM 2021, 7). It is recommended to have a new training programme which will enable your workforce to become carbon literate.

What follows are some practical suggestions for areas such as:

- Building renovation/Energy <sup>[P9]</sup>
- Mobility – Low-carbon travel guidance <sup>[P10]</sup>
- Administrative operations efficiency <sup>[P10]</sup>
- Digital and electronics <sup>[P10]</sup>
- Emails <sup>[P10]</sup>
- Advertising <sup>[P13]</sup>
- Water <sup>[P13]</sup>
- Catering <sup>[P13]</sup>
- Waste <sup>[P14]</sup>
- Greenery/Biodiversity <sup>[P14]</sup>
- Community building/Outreach and education <sup>[P14]</sup>

**3.1 Building renovation/Energy**

- Install or switch to renewable energy:<sup>2</sup> energy supply is the most important step towards reducing emissions. E.g. The Design Museum in Kensington, London, managed to cut total emissions by 95% when switching to renewable energy (Sommer et al. 2021).
- Replace fossil fuel-based building systems (e.g. natural gas space and water heaters) with electric systems, which can be fossil fuel free if powered by on- or off-site renewable energy or a carbon-free electric grid.
- Improve building efficiency: improve insulation of walls, roofs, and windows.

<sup>2</sup> For your information: Technically speaking, unless you have your own renewable generation connecting directly to your building, then the electricity comes from the same national grid as everybody else’s. Having said that, it is important to switch because it stimulates demand and strengthens suppliers with a good reputation that invest in renewables.

- Operational energy: lower the amount of energy that a building consumes for heating, cooling, ventilation, lighting, equipment, and appliances by upgrading the heating and cooling systems, updating lightning – switching to LED and installing motion sensors (Regeneration 2021a).
- Lower the air temperature by shading the walls and courtyards with vegetation. Shaded walls and surfaces may be 11–25°C cooler than unshaded surfaces (2030 Palette, n.d.).
- Consider renovating your roof into a green roof to ensure water retention, improved water and air quality, and reduce energy consumption (2030 Palette, n.d.). See more under section Greenery/Biodiversity.

### 3.2 Mobility – Low-carbon travel guidance <sup>[103]</sup>

- Encourage employees to walk, cycle or use public transport to come to the workplace by
  - allowing flexible work schedules,
  - enabling employees to work remotely,
  - installing showers and bike lockers,
  - offering employment benefits such as subsidised public transport season tickets.
- Business trips:
  - Rail travel should be considered as the first option. Flights are only considered if train travel time is excessive or is prohibitively expensive.
  - When flying is the only viable option, answer the following questions: Are you getting the maximum value for your trip? Can this trip be combined with other activities to prevent another journey in the future? Can you attend another event for a colleague to prevent them from flying?
- Encourage visitors to walk, cycle or use public transport to visit the museum by
  - promoting sustainable travel options,
  - providing real-time information on public transport (Regeneration 2021c),
  - creating bicycle parking to encourage museum staff and visitors to cycle,
  - offering entrance fee discounts.

### 3.3 Administrative operations efficiency

- Establish a responsible policy for the use of administrative consumables.
- Seek suppliers that share your net-zero ambitions.
- Turn off video in a Zoom meeting (Tam 2021).
- Establish a low-print policy (print only the essentials) with a move to digital communication, including reports for Municipalities and Ministries.
- If you print, do it double-sided in black & white, and use 100% recycled unbleached, chlorine-free paper. Certificates to look for:
  - PCF – processed chlorine free or
  - TCF – totally chlorine free.
  - Alternatively, if recycled paper is not available, use FSC certified paper.

### 3.4 Digital and electronics

- Store data in the cloud rather than storing it on computers. Use cloud services that are powered by renewable energy.
- Use a sustainable search engine (e.g. Ecosia).
- Delete apps on devices you don't use – they require data and energy.
- Purchase refurbished electronic devices over new ones.
- Use electronic devices for as long as possible, repair them if possible, pass them onto new users and recycle them at the end of their life cycle.

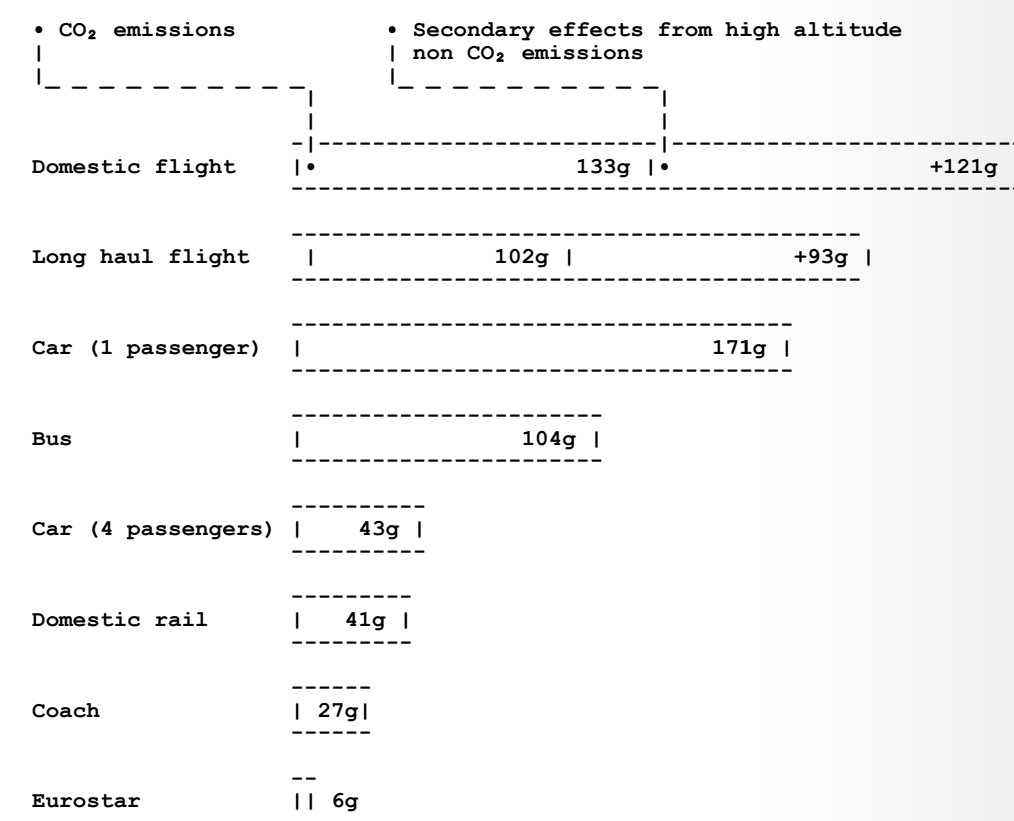
### 3.5 Emails

- Reduce the volume of email communications – be a mindful email sender and receiver: reduce the amount of pointless “thank you” emails, etc.
- Use the ‘Plain text’ format instead of the ‘Rich text’ format.

### Infographic 3

#### EMISSIONS PER PASSENGER PER KM TRAVELLED FROM DIFFERENT MODES OF TRANSPORT

Unit: g CO<sub>2</sub>/passenger/km



Note: Car refers to an average diesel car

Source: BEIS 2020

### Case Study 2

#### RE-EVALUATING CORPORATE SPONSORSHIP

For the last 20 years a number of art institutions have been the subject of many environmental protests, sparking a debate on museum neutrality and highlighting how oil companies have utilised the arts as a way to deflect scrutiny for decades. Many arts institutions have been forced to review how they embody their values and social purpose, not only in the programmes they produce, but also the way they do business. Following the increased pressure from protesters and artists alike, *The Tate parted ways with oil giant BP in 2017 after three decades of sponsorship, with the Royal Shakespeare Company and the National Galleries of Scotland following suit in 2019, severing ties with BP two years earlier than the original agreement. The National Theatre, similarly, has cancelled the corporate gold membership of oil and gas company Shell as part of their plan to become carbon neutral.*

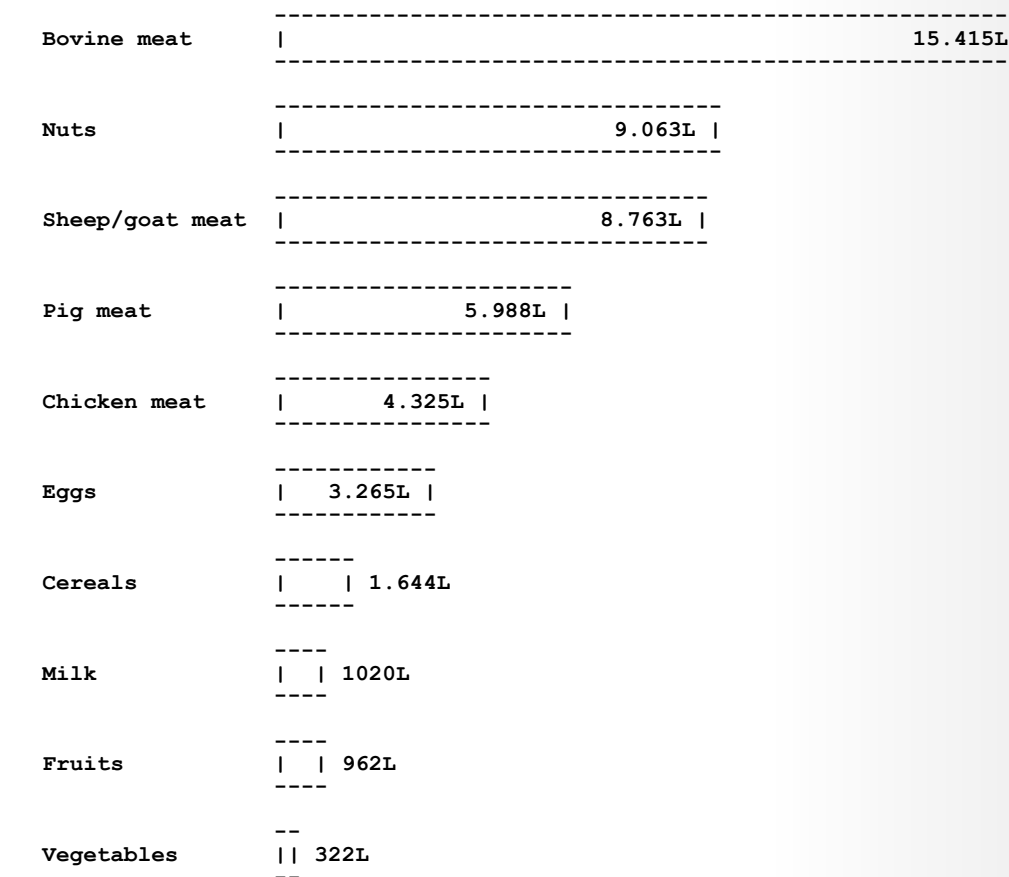


Activists spill symbolic oil at the Louvre to protest its sponsorship deal with French multinational oil and gas company Total S.A., 2016  
Photo: Denis Meyer. Source: Libérons le Louvre (360.org)

### Infographic 4

#### HOW THIRSTY IS OUR FOOD?

Unit: L of water/kg of food



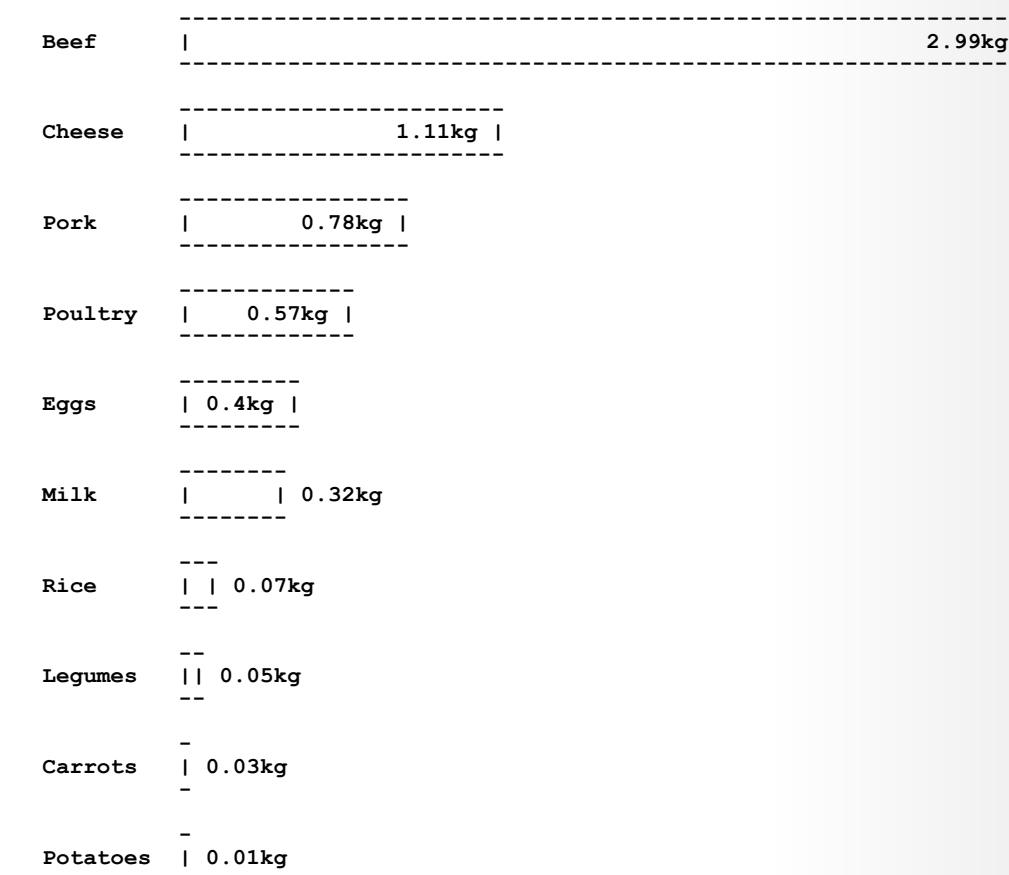
The diagram shows litres of water required to produce one kilogram of the listed food products (global averages)

Source: Water Footprint Network

### Infographic 5

#### FOOD CARBON FOOTPRINT CALCULATOR

Unit: kg CO<sub>2</sub>e/serving



Source: University of Michigan

- Avoid the use of embedded graphics in your email signature.
- Rather than sending attachments via email, set up a sharepoint accessible to everyone on the project.
- Delete all the emails that don't need to be stored.
- Unsubscribe from email subscriptions you don't read.
- Place a whiteboard in a common area and use it for internal communication. This might save some emails.

### 3.6 Advertising <sup>[CS2]</sup>

- As the institution's website is its primary tool of information dissemination, it can become one of the biggest sources of CO<sub>2</sub> emissions when it comes to communication. The most effective way to reduce a website's carbon footprint is to switch to a green web host, essentially a hosting company whose operations are powered by renewable energy (e.g. GreenGeeks, Kualo, Runbox).
- Choosing the right type of advertising depends on your strategy. When it comes to shorter campaigns, stick to digital (social media, outdoor digital displays), while traditional printed posters and billboards are more suitable for longer run campaigns.
- Consider transit system advertising, including bus, rail, subway, and bike shares. This helps municipalities to fund and support these vital public resources.
- Make sure your efforts and values are reflected in your strategic partners, advertisers, and sponsors. Re-examine existing relationships and seek to form new ones with businesses and institutions that share your commitment towards sustainability.

### 3.7 Water <sup>[164]</sup>

- Reduce water consumption (indoor and outdoor).
- Use tap water instead of bottled – in the museum, restaurant, and café.
- Install water-saving technology (Cole et al. 2011), i.e. toilets updated with water-saving technology and devices.
- Install a rainwater tank to water the green areas surrounding the museum (CIMAM 2021, 9).
- Capture and reuse greywater and/or blackwater (AIA 2020a).
- For cleaning, avoid environmentally harmful detergents, like 1,4-dioxane, sodium laureth sulfate, bleach, and formaldehyde. Look for eco-label certification or similar (Dillon 2021, 43).
- Change diets. We can significantly reduce our water footprint by eating less water-intensive foods. See more under section Catering.

### 3.8 Catering <sup>[165]</sup>

- Provide more diverse foods.
- Significantly reduce the consumption of meat and dairy products.
- Avoid highly processed and engineered meat substitutes.
- If providing meat, fish, dairy and eggs, look for responsibly sourced, organic and free-range options.
- Grow your own garden.
- Buy seasonal produce from local providers who value crop diversity and traditional food cultures. Also increase access to information on just and sustainable local food (Regeneration 2021b).
- Promote seasonal eating.
- Reduce food waste.
- Certificates to look for:
  - Purchase products with RSPO-certified palm oil where possible.
  - Agricultural produce:
    - EU organic products label
    - Fairtrade International
    - Soil Association
    - Rainforest Alliance
  - Seafood:
    - Marine Stewardship Council (MSC)
    - Aquaculture Stewardship Council (ASC)
- Provide food that is suitable for other species as well. (E.g. *Why not have catering in MAO's backyard where ducks and nutrias would also be welcome?*)

### 3.9 Waste <sup>[166]</sup>

- Nurture a zero-waste culture by making reducing and reusing a priority.
- Capture all the compostables.
- Keep recyclables out of landfills.
- Reduce, reuse and recycle more construction, renovation, and demolition waste.
- Foster a closed-loop economy (Cole et al. 2011).
- Don't use single-use plastic (cups, cutlery, bags, garbage bags, etc.).
- Partner with like-minded museums and venues to share and reuse resources (CIMAM 2021, 9).
- And don't forget the golden rule: The most effective way to reduce waste is to not create it in the first place.

### 3.10 Greenery/Biodiversity

In addition to the potential steps already mentioned (shading the walls and green roof):

- Understand how human interaction has impacted local ecosystems.
- Protect and increase permeable and green surfaces – remove pavement and put in plants and trees instead. Identify and protect the species on the site.
- Plant native plants to intentionally maximise biodiversity, support pollinators, and create habitat for endangered species.
- Practise urban agriculture.
- Develop and manage wildlife corridors and habitats (Regeneration 2021d).
- Provide shelter and food sources for different native species.
- Create natural night-time habitat conditions by eliminating unnecessary artificial light and sounds while no humans are present (AIA 2020b).
- The museum and its surroundings should help visitors become more aware and connected with the place and the regional ecosystem (AIA 2020b).

### 3.11 Community building/Outreach and education

As Kate Raworth wrote, inequality “is not an economic necessity: it is a design failure. [...] There are many ways to design economies to be far more distributive of the value that they generate – an idea best represented as a network of flows. It means going beyond redistributing income to exploring ways of redistributing wealth, particularly the wealth that lies in controlling land, enterprise, technology, knowledge, and the power to create money” (Raworth 2018, 29).

With society facing issues such as poverty, inequality, intolerance, and discrimination, museums can help us understand, debate, and challenge these concerns. They can also enhance everyone's life chances by breaking down barriers to access and inclusion. Museums are doing this through active public participation, engaging with diverse communities, and sharing collections and knowledge in ways that are transforming lives (Museums Association 2017).

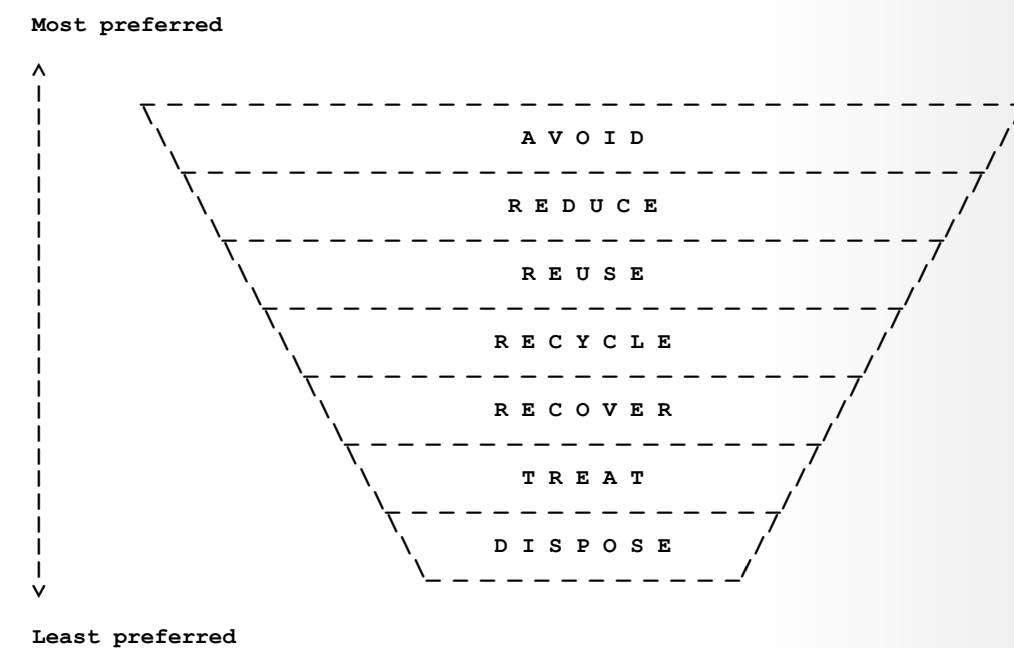
What museums should focus on is:

- diversity and distribution,
- and ways to inspire others to take collective action.

In other words: Through public programmes you can begin to inspire and support your visitors to make choices to increase their positive impact on the environment. Connect educational activities with sustainable practices – growing a museum garden can be a children's workshop, while cycling to the museum can be a part of an architectural and design exhibition.

Last but not least: work with others and lead by example.

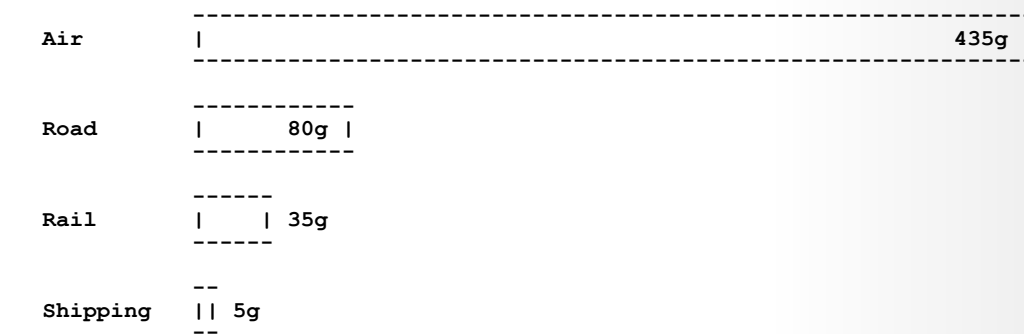
### Infographic 6 WASTE PYRAMID



Source: A Zero Waste hierarchy for Europe (Simon 2019)

### Infographic 7 EMISSIONS BY MODE OF TRANSPORT

Unit: g CO<sub>2</sub>/ton-km



A large vessel emits 1% of CO<sub>2</sub> per ton-km of a plane (5/435) and 14% of a cargo train (5/35).

Source: IMO GHG study 2009

### Case Study 3 BIO27

*While sleek exhibition setups housed in white-cube spaces where construction materials are hidden underneath shiny surfaces might be the industry standard, these materials can often be very harmful towards the environment and are usually difficult to recycle. With this in mind, Studio Medproster searched for alternative ways of building up the exhibition for BIO27. Looking into local traditions of woodworking, they discovered that the percentage of forests in Slovenia has almost doubled in the last 150 years. Given the abundance of locally available wood, it was only natural to use it for this exhibition, with Studio Medprostor looking at how to approach the material in a non-destructive way. Rather than buying wood, they worked out a deal with a local wood supplier to borrow firewood for the duration of BIO27. Recognising the exhibition design as part of the content and not solely as a pedestal for the works exhibited, they decided to emphasise it as part of the narrative by leaving the material on display. The logs were secured with straps that allowed for easy assembly and disassembly, which were sourced from Luka Koper and reused for the exhibition, rather than being disposed of. After the exhibition the logs were returned and put back for sale, radically reducing the impact of the exhibition setup.*

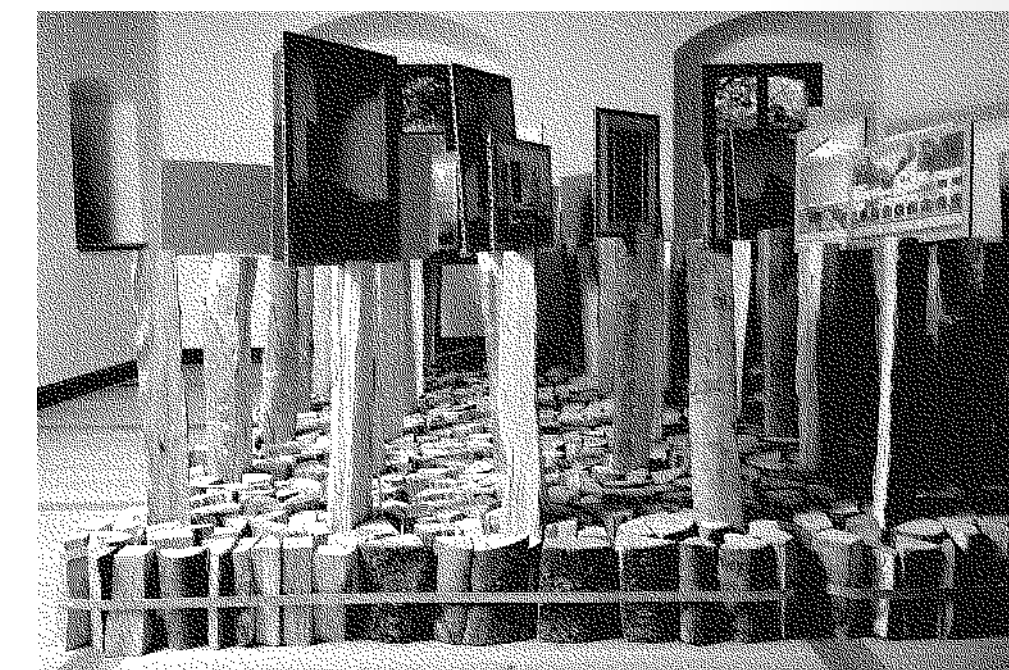


Photo of the installation by Klemen Ilovar.

## 4 EXHIBITION AND EXHIBITION DESIGN

In the article “The role of architecture in an engaging and meaningful experience of the physical exhibition” Bárbara Coutinho and Ana Tostões highlight that we live in “times of profound challenges and possibilities for curatorial practice. Digital transformation is enabling improved conservation and study of artworks, while virtual museums and exhibitions are able to disseminate their images globally, democratising art.

However, the resulting disconnect from the surrounding physical environment and the dematerialisation of the experience of art can contribute to what [Juhani] Pallasmaa calls ‘the tactile and sensorial desensitisation of man’, reducing the vital importance of the arts to the overall development of humankind. Consequently, it is crucial to rethink the physical exhibition, and to do so with sensitivity and responsibility” (Coutinho and Tostões 2020, 38).

The latter is even more true in the context of considerations in relation to burning climate-change issues. For this purpose, the exhibition space should be reconsidered as part of the content, as a narrative, and not solely as a pedestal for the exhibition of works.

### Practical steps

What follows are all viable approaches towards a greener exhibition, but nevertheless not always necessarily right for the situation at hand. They require thoughtful deliberation and close collaboration of all parties involved. Even though some gold standards might not be achievable based on the resources at hand, work within your local network to search for best possible solutions.

The “Exhibition and Exhibition Design” chapter is divided into five main topics:

- Programme <sup>[P17]</sup>
- Shipping/Transport <sup>[T17]</sup>
- Materials <sup>[M18]</sup>
- Construction/Deconstruction of the Exhibition <sup>[P21]</sup>
- Electronics <sup>[P21]</sup>

#### 4.1 Programme

- Extend the duration of exhibitions to over 3 and a half months or even longer (CIMAM 2021, 4).
- Focus more on local artists and works from the museum's collection.
- International exhibitions can be installed remotely, without the artists and external curators.
- Offer virtual materials for families, learners, the disabled, and everyone to access online (CIMAM 2021, 4).

#### 4.2 Shipping/Transport <sup>[T17]</sup>

Making exhibitions sustainable needs a significant reduction in transport and deliveries. To achieve this, we need to:

- Avoid transportation by air.
- If possible, avoid transportation whatsoever and rather recreate the work locally.
- When transporting works, analyse in each case which is the most suitable transport for the artwork and the environment (CIMAM 2021, 4).
- Work with contributing designers to gather data about their complex supply chains (Hahn 2021).
- Make sure to minimise the volume and weight of the packages.
- While designing packaging:
  - use Velcro, bungee cords, fabric ties or other reusable alternatives to plastic cable ties or PVC tape;
  - avoid non-recyclable and non-reusable materials such as bubble wrap;
  - prioritise use of reusable crates; avoid painting your crates to make recycling easier;
  - use recycled paper or cardboard (Barbican 2021).

### 4.3 Materials <sup>[CS3, IGS]</sup>

When approaching the design of your exhibition from the material point of view, there are five distinct approaches towards lowering your carbon footprint:

1. Re-using existing display pieces.
2. Reclaiming leftover/used/waste materials from factories and other businesses before they get discarded (in this way, the environmental impact of your work will be negative since you will avoid the production of new materials and prevent disposal/incineration of materials that are considered waste).
3. ‘Borrowing’ materials from local suppliers for the duration of the exhibition (by employing this principle, you will avoid the production of new materials and prolong the life cycles of the materials you are borrowing).
4. Designing with the reuse of all the included materials in mind – making the objects simple to disassemble and reassemble again as well as convenient for further use.
5. Or investing in low-impact materials.

To get the basic idea about the CO<sub>2</sub> emissions of materials, see Infographic 9. The latter features calculations for some of the most commonly used materials in exhibition design. <sup>[IG9]</sup>

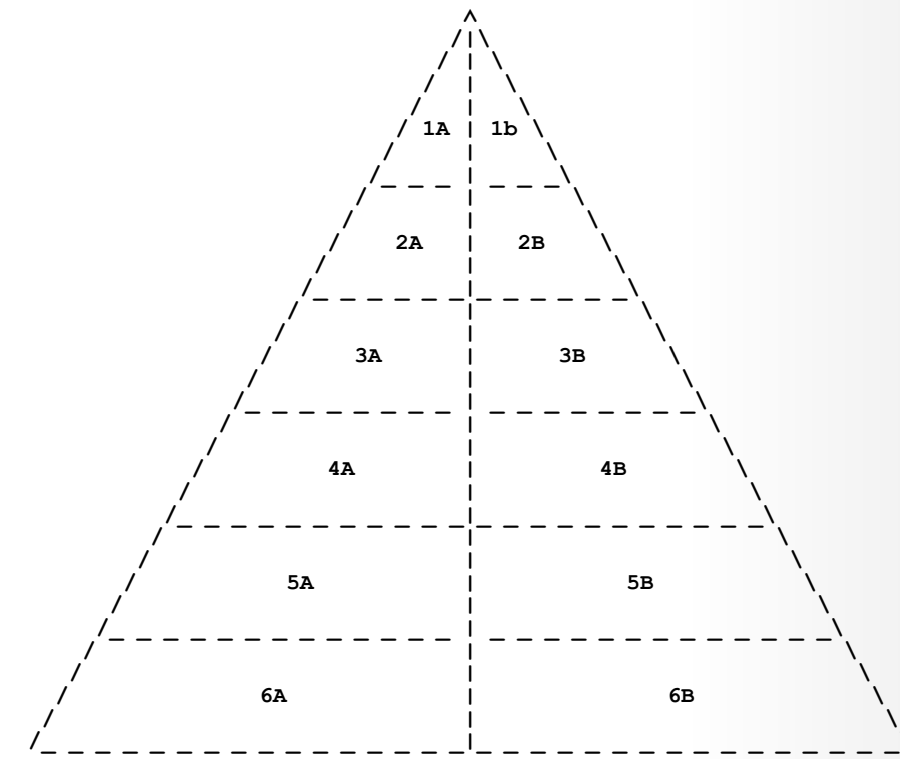
What else to keep in mind?

- Reduce material quantities where possible (Barbican 2021). If you are reducing material weight you are reducing impact.
- Make a “material inventory” of the museum and identify what can be reused.
- If possible, create closed material loops with local suppliers. See if you can borrow materials, use them in a non-destructive way, and return them after the exhibition.
- Use low-impact construction materials that could be reused or left to biodegrade without causing harm to the environment (Hahn 2021).
- Use the ‘right’ material for the ‘right’ use – e.g. short-lived vs long-lived.
- Find materials that are sourced and produced as locally as possible.
- When possible, use recycled materials instead of virgin materials. E.g. the production of virgin aluminium emits 12.36 kg CO<sub>2</sub> per kg of material, while recycled aluminium emits only 5% of that value, which is 0.63 kg CO<sub>2</sub> per kg of material. <sup>[IG10]</sup>
- Keep track of all carbon data during the design phase to make sure you are making the right decisions along the way and avoid discovering mistakes when it is too late for corrections.
- Wooden materials should be FSC-certified. FSC certification ensures that products come from responsibly managed forests that provide environmental, social, and economic benefits (Pentagram 2009).
- Look for materials and products that are Cradle to Cradle Certified. It is the global standard for products that are safe, circular, and responsibly made.
- When planning on substituting a material, consider whether that makes sense (choose the best possible option as locally as possible). Also keep an eye out for hidden sources of CO<sub>2</sub> emissions such as fixtures. When deciding on substituting the traditional aluminium system with cross-laminated timber frames for the remaining partitions, for the Waste Age exhibition at the Design Museum in London, they managed to save 1.9 tonnes of CO<sub>2</sub>. This represents roughly 20% of the total footprint, but was negated by the need of 4,800 stainless steel decking screws to hold the construction together, which added an additional 1.2 tonnes of CO<sub>2</sub> emissions (Hahn 2021).
- Use non-toxic, water-based paints with low levels of volatile organic compounds (Julie’s Bicycle 2022).

Some examples of low CO<sub>2</sub> footprint construction materials:

- Green Cast — 100% recycled and recyclable cast acrylic sheets
- Lemix clayboards — composed of clay, earth, wood fibre, starch, and hessian mesh, they combine the advantages of modern, modular drywall construction with the engineering characteristics of clay as a natural building material.
- Woodcrete wall units — formed from cement-bonded wood fibre material. 90% of woodcrete blocks are made from softwood aggregates which are by-products of the timber industry.

### Infographic 8 THE MATERIALS HIERARCHY



Material origin	Material afterlife
1A Unnecessary materials designed out	1B Unnecessary materials designed out
2A A previous life locally or at venue (storage, second hand, rental, other productions)	2B Sold, donated, stored locally or at venue
3A A previous life in the region (storage, second hand, rental, other productions, online sharing or swapping networks)	3B Sold, donated, stored regionally
4A Repurposed or net zero materials: reused timber or steel, recycled materials or offcuts	4B Dissembled and recycled
5A Low carbon raw materials: timber, board or recycled steel, natural and organic materials	5B Burnt as biomass for heating
6A Virgin and raw materials: steel, tropical hardwoods, synthetic textiles, glitters, toxic paints and dyes, PVC (avoid)	6B Landfill (avoid)

Source: The Theatre Green Book (Part 1)

### Infographic 9 MOST COMMONLY USED MATERIALS

Unit: kg CO<sub>2</sub>e/kg material

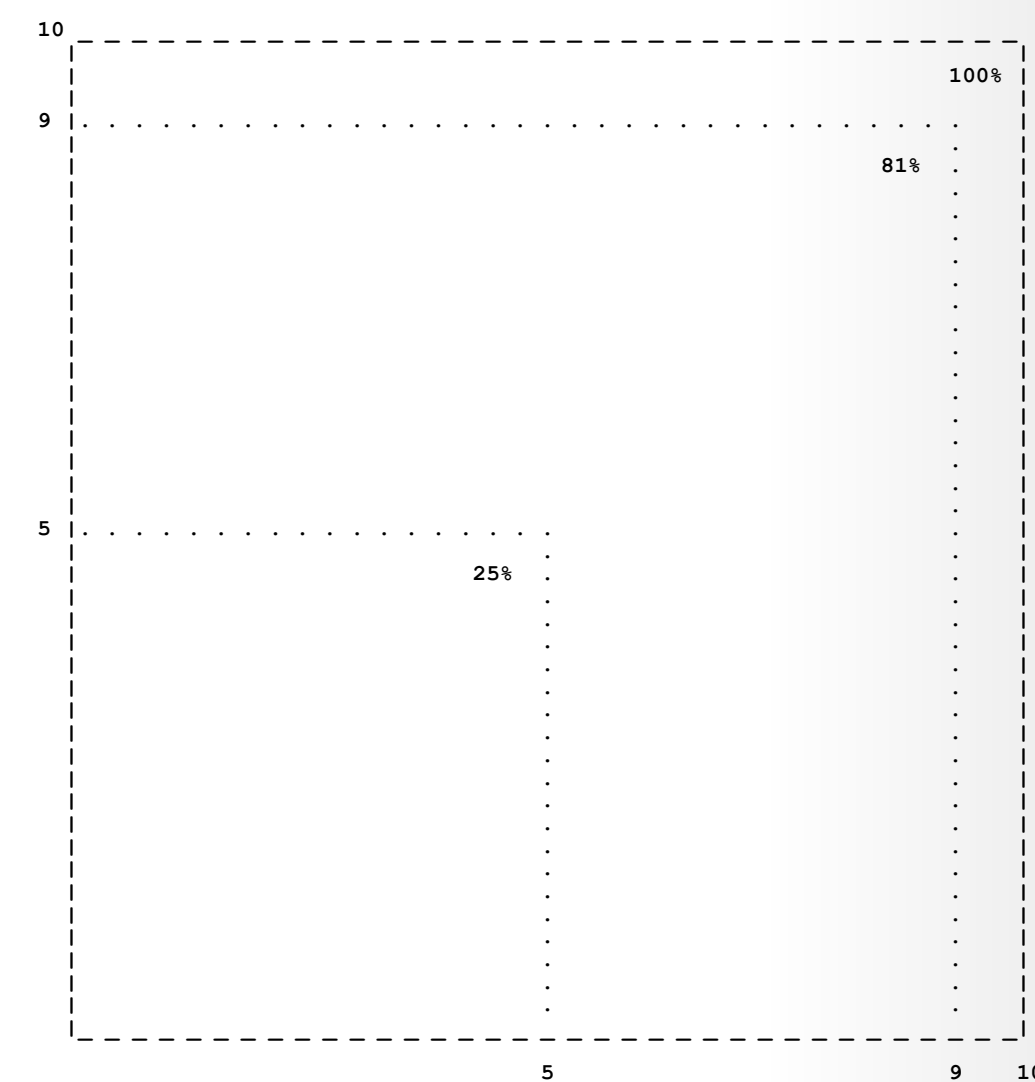
Hardwood	0.306kg
Toughened glass	1.67kg
Plywood	0.681kg
Aluminium (virgin)	12.36kg
Plasterboard	0.39kg

### Infographic 10 VIRGIN ALUMINIUM VS. RECYCLED ALUMINIUM

Unit: kg CO<sub>2</sub>e/kg material

Virgin aluminium	12.36kg
Recycled aluminium	0.63kg

### Infographic 11 REDUCING INK USAGE



If you reduce the image by 10% (as initially desired), you will get a 19% cost saving in ink. If the image is reduced by half, the ink usage is reduced by 75%. Most customers will accept at least a 10% image size reduction.

Source: AnaJet, Inc. 2009

- Sould acoustic panelling — made by upcycling eelgrass, an overlooked natural material.
- Lehmbauplatten building boards — made from sand, hemp fibres, and clay, they offer a natural alternative to plasterboard.
- Amroc — cement-bonded particle board produced from coniferous wood chips and Portland cement, in combination with mineralisation agents and water (SPACE10 Gallery 2021).
- Honext — a natural and always recyclable material with excellent properties, made from cellulosic waste.

### Materials to avoid

- Tropical hardwood
- Virgin steel
- MDF
- Petroleum-based materials such as resin and acrylic
- Materials which are hard to recycle or reuse such as composite plastics, polystyrene and PVC
- Harmful chemicals including aerosols, parabens and triclosan
- Environmentally harmful detergents such as 1,4-dioxane, sodium laureth sulfate, bleach, and formaldehyde
- Single-use plastics (Barbican 2021)

To conclude the “Material” section, let’s recap what the 2 key principles are:

1. Everything in a truly sustainable exhibition will have had a previous life.
2. Everything will be used again (Dillon 2021, 14).

### 4.4 Construction/Deconstruction of the Exhibition

When planning an exhibition, it is as important to think as much of how it will be deconstructed as how it will be put up. Standard fastening methods such as spot welding, strong adhesives, and nail plates may be very convenient for assembly but make it hard to disassemble and reuse the materials (Dillon 2021, 46).

What to keep in mind while designing:

- Consider hiring or borrowing before buying new equipment (Julie’s Bicycle 2022)
- Simple structures, fewer parts.
- Modular design.
- Aim for standard dimensions and elements.
- Sets, walls and displays should be designed to be easily dismantled, re-used, re-purposed, or recycled. Avoid constructing stud-walls, structures, and shapes which are hard to reuse and produce excessive waste.
- Use reversible methods of fastening – minimise the use of glue and nails to enable simple deconstruction at the end of a show.
- Prepare drawings and instructions for disassembly.
- Keep a detailed list of all components, fasteners, etc. included in constructions.
- Label the parts of constructions clearly.
- Ensure that recyclable materials are placed within the correct recycling infrastructure.
- Research institutions, charities, and projects that can repurpose used materials.
- AV equipment should be re-used in future exhibitions otherwise donated.
- Make inventories for all materials used in the exhibition and plan their disposal routes (Barbican 2021).

### 4.5 Electronics

- Keep an up-to-date inventory of all devices available.
- Prioritise the re-use of electronics.
- Make sure electronic equipment is regularly serviced.
- If new AV equipment must be purchased, make sure it is ethically sourced.
- Use energy efficient equipment if available, e.g. low wattage, A+++ rating.
- Use LED lighting.
- Design controls for the exhibition space and electrical equipment for easy power turn off, to be switched off when not in use.
- Use rechargeable instead of disposable batteries for electrical equipment (Barbican 2021).

It is important to stress that “this challenge is not only technical; it is creative and social. Design has a critical role to play” (Design Council 2021, 6).

Why?

- 80% of environmental impacts are determined at the design stage (Charter et al. 2020, 39).
- 90% of manufacturing costs are determined at the design stage.
- 40% of manufacturing costs go on materials.
- 5% of a product’s costs is all that is needed for good design (Sherry and O’Connor 2021).

**Practical steps**

A key understanding while designing is that net-zero energy design is possible only through a collaboration between clients, designers, and the involvement of all stakeholders (printing house, etc.). Next to that, it is crucial to keep in mind that some impacts are more controllable than others and that we have to operate within a regional context where some services and resources may not be available.

Therefore, the purpose of the following guides is to show what is possible and what the most recent materials and technologies offer, but if it turns out that finding a path within all the limitations is too demanding, it is only reasonable to make compromises. Start by aiming for the most effective solutions but do not get discouraged if not everything goes as planned. All efforts count.

What else to be mindful of?

- Consider the volume of catalogues/brochures/exhibition maps you are printing. Rather than printing in large quantities for cheap abroad, choose a local, more expensive option and print smaller quantities.
- With printed media, locate printing businesses that follow carbon-neutral standards, run on renewable energy, and are investing in low-impact machines.
- To avoid paper/vinyl substrate, photographs and graphics can be printed on recycled aluminium panels using a process called direct-to-substrate dye-sublimation printing.

Three main sections follow:

- Layout Design <sup>[P22]</sup>
- Printing <sup>[P25]</sup>
- Signage <sup>[P25]</sup>

**5.1 Layout Design**

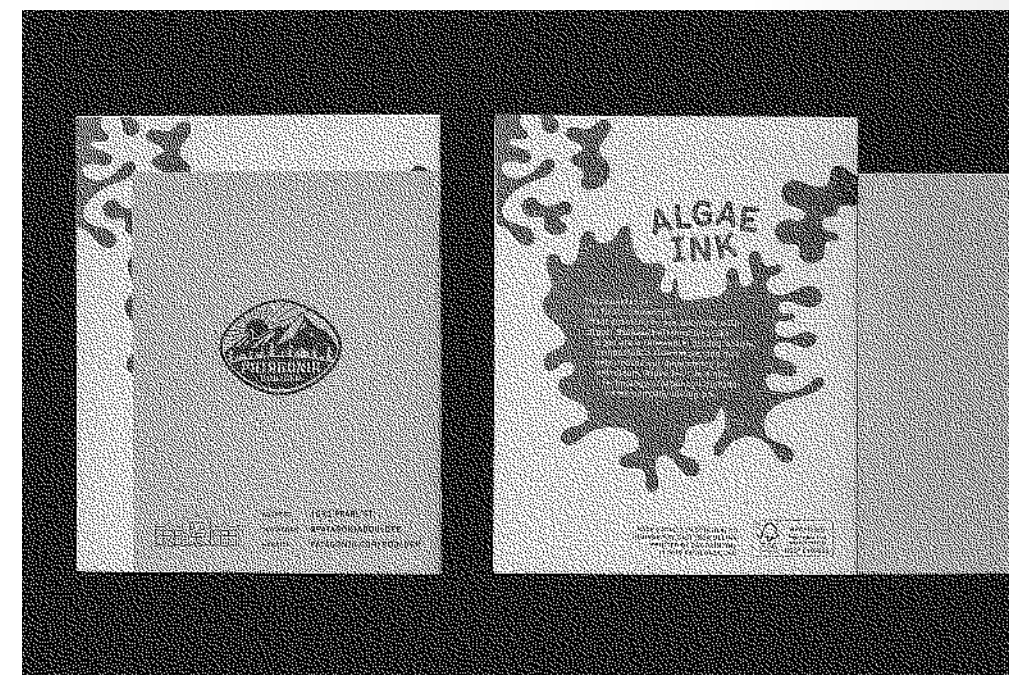
- Paper has the biggest impact in printed media; therefore, when designing, avoid large areas of negative space. Compress your design and minimise formatting to maximise coverage and reduce paper usage.
- Ask your printer for advice about the best use of paper through efficient imposition.
- Stick to standardised paper sizes in order to reduce trimmings.
- To further reduce waste, avoid designs that go to the edge. Leaving a blank border eliminates the need for bleed space and trimming. Full bleed ink coverage also makes it harder to recycle the paper.
- Avoid dark, highly saturated colours as they consume more ink than lighter ones.
- Consider using fonts that use less ink when printed.
- Ideally opt for a B/W colour scheme to reduce ink wastage.

**Pictures/Images** <sup>[IG11]</sup>

- Minimise the use of high-resolution and highly saturated pictures as much as possible. Use simple schematics as an alternative whenever possible.
- If using pictures in your design, lower their resolution and saturation to reduce ink consumption. This can be further reduced by printing grayscale or running your pictures through a halftone filter.

**Case Study 4  
ALGAE INK**

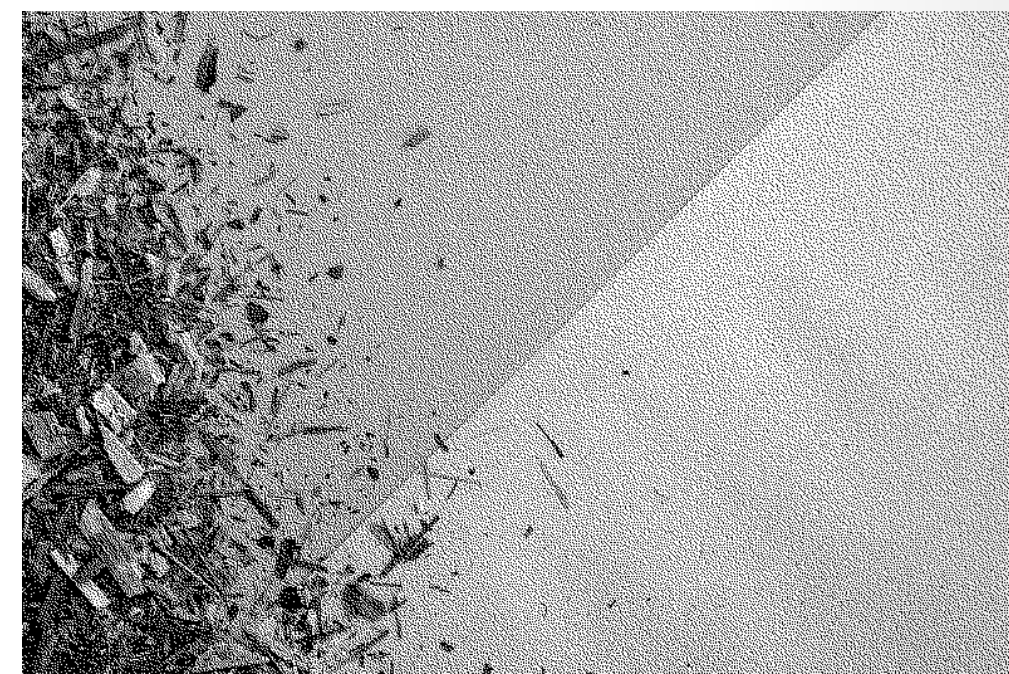
*Even the most eco-friendly (water-based or soya-based) inks use pigments made with oil or petroleum. Developed by Living Ink Technologies, Algae Ink is the first commercially available ink that utilises algae cells for pigments, making it completely bio-based and renewable. Depending on the type of ink, 2.5–20% of the ink is bio-based pigment. With large-scale production, algae pigments are carbon negative since algae absorb atmospheric carbon dioxide and the ink locks it in for over 100 years. Using a 20,4-kg bucket of Algae Ink can remove 59 kg of carbon dioxide from the atmosphere. Additionally, every 20,4 kg of Algae Ink produced keeps 10.2 kg of petroleum from being used. Next to that, algae grow faster than terrestrial plants and do not use traditional farmland, thus its production does not displace food production.*



Boulder city guide by Cast Iron Design made with ink derived from algae  
Source: Patagonia

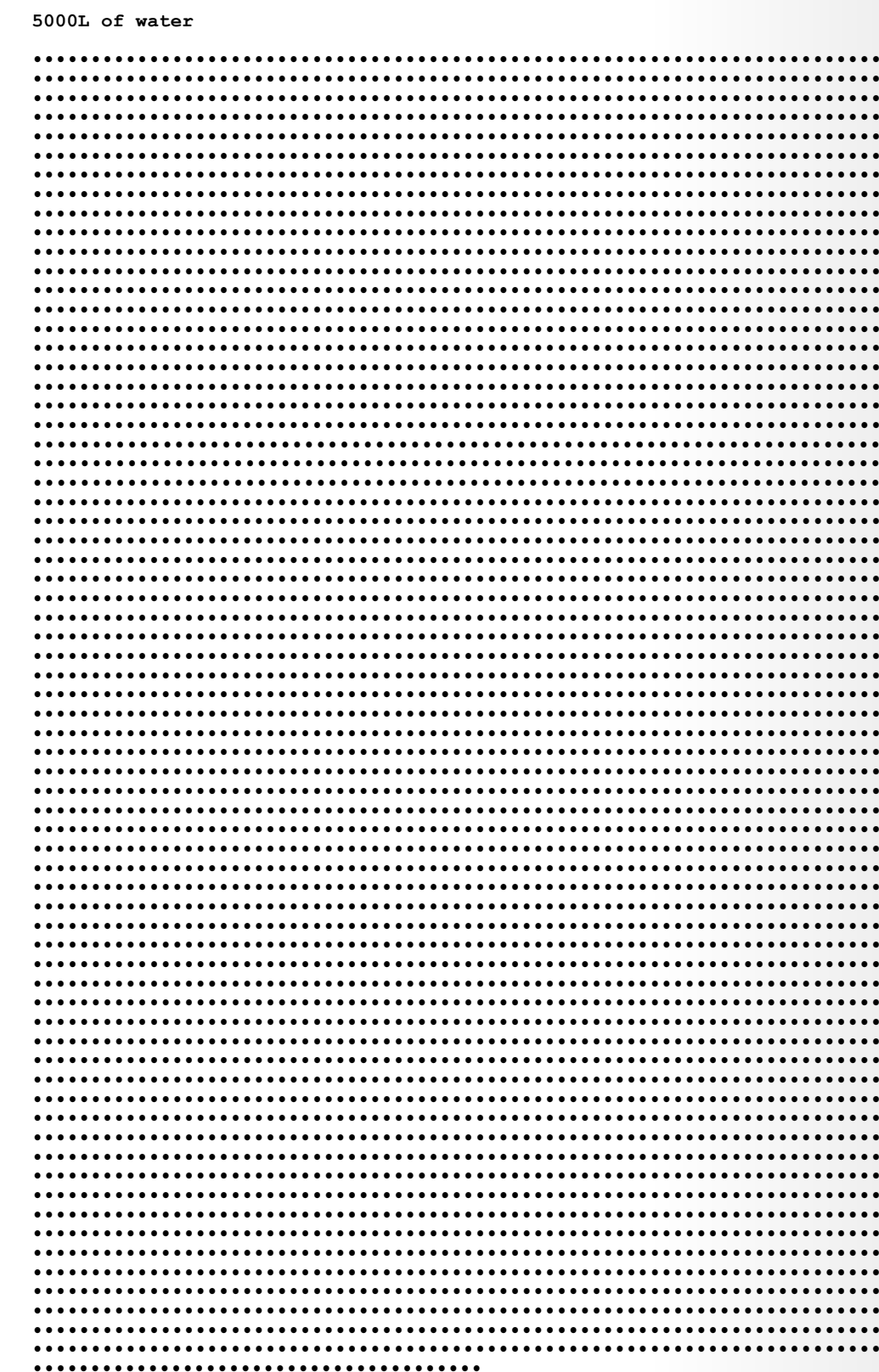
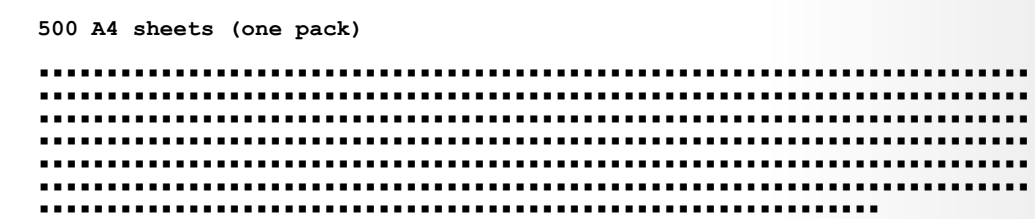
**Case Study 5  
NOTWEED PAPER**

*Notweed Paper is the first manufactured paper making use of invasive plants, found by a Slovenian non-profit organisation Trajna. Made of 50% locally-sourced Japanese knotweed cellulose, the initiative helps turn plants that otherwise cause distress to local authorities and landowners into something useful and valuable. On the one hand, Notweed Paper protects forests by replacing virgin wood fibre with the abundant biomass of invasive species, and on the other hand, it contains the unwanted spread of the latter. The other ingredients are 45% wood cellulose and 5% waste paper. Notweed Paper is unbleached and therefore chlorine-free, which additionally contributes to a lower environmental impact.*



Notweed Paper by Trajna  
Source: Trajna

**Infographic 12  
5000 LITRES OF WATER FOR ONE PACK (500 A4 SHEETS)**



Assuming 80g/m<sup>2</sup> paper and that it is produced from wood. The amount of 10 litres for one A4 sheet of paper obviously varies, depending on the source of the wood. Particularly, forest evapotranspiration and wood yield vary from forest to forest. The number will likely fall in a range of 2 to 30 litres of water per A4 sheet. This variation alone makes it so important to pay close attention to this number in our choice of paper.

Source: Queen Mary University of London

- Rethink image size in your publication. Reducing image sizes has a tremendous effect on ink volume (AnaJet 2009).

**5.2 Printing**

- Minimise the number of test prints (Julie’s Bicycle 2022).
- Before printing, double and triple check for typos and mistakes. A lot of impact comes from last minute mistakes that aren’t captured before being sent to the printers.
- Use waterless offset printing if possible.
- Consider using traditional printing methods like screen printing or stencils whenever applicable.

**Ink** <sup>[CS4]</sup>

- Consider laser cutting, engraving, or embossing as sustainable alternatives to ink printing.
- If using ink, search for alcohol (VOC) free options, soya- and vegetable- or water-based inks.
- Avoid metallic inks, fluorescent inks, and petroleum-based inks (Julie’s Bicycle 2022).
- Always print double-sided.

**Paper** <sup>[CS5, IG12]</sup>

When it comes to paper, don’t look only into its CO<sub>2</sub> emissions but rather the overall impact. Get to know the different certificates, as they will tell you a lot about the sourcing and processing of the paper.

You should ask your paper supplier for the following information:

- Where do you source wood fibre from? (location, type of forest management)
- Where are your manufacturing facilities located?
- Which certificates do your business and paper products obtain?
- Do your facilities run on renewable energy?
- What type of bleaching technology do you use?

What to keep in mind when choosing paper?

- Use recycled, chlorine-free paper (PCF – processed chlorine free, TCF – totally chlorine free).
- Alternatively, source FSC certified paper. The FSC certificate ensures that products come from responsibly managed forests that provide environmental, social, and economic benefits.
- Search for locally produced paper; even if it’s not recycled or does not have all of the certificates, the short transport distance could result in a lower impact than a recycled one imported from across the world.
- If using imported paper, work with the suppliers to find a certified paper produced as close as possible.

**Coating**

- Avoid laminations and over-print varnishes.
- Choose no coating if possible.
- Otherwise choose UV coating or water-based coatings (Julie’s Bicycle 2022).

**Binding**

- Instead of the perfect binding, which makes recycling harder, opt for saddle stitch or coil binding or invest in recycled aluminium spirals as an eco-friendly alternative for your publication.
- If using adhesives, choose VOC-free certified options.

**Packaging**

- Minimise packaging for printed material transportation.
- Use recycled paper/cardboard instead of single use plastics.

**5.3 Signage**

Historically, signage has been produced using materials that are not environmentally friendly. There are, however, more and more materials available that have recycled content or that can be reused. Apart from the guidelines previously mentioned in this section, there are some particular things you should look out for when planning the signage for your exhibition.

What to keep in mind?

- When designing your signage, consider the type of exhibition you are planning. For example, if you are planning a temporary exhibition, avoid creating panels or banners made from materials that will survive for hundreds of years.
- Find and build relationships with suppliers who understand your needs and have a selection of sustainable material options with good specifications and certifications.
- If you want to use more solid materials, search for suppliers who are willing and able to take the material back to be recycled.
- Make sure the signage you create will last the duration of the exhibition and won't have to be replaced. Keep an eye out for inks that are not UV stable and fade quickly.
- Before printing, double and triple check for typos and mistakes. A lot of impact comes from last minute mistakes that aren't captured before being sent to the printers.

### Indoor signage

- Consider using mono-materials, products that are composed only of a single type of material. These are typically easier to recycle and require less energy than material composites.
- Be mindful about legibility and size. Do not reduce the size of the signage to the point where it does not do its job of communication.
- Don't over-specify the materials. The signage for the Waste Age exhibition, designed by studio Spin, was printed directly onto the walls using a 'print gun', avoiding the need for additional materials completely.
- Avoid using many different colours in your signage and consider instead adopting a mostly monochromatic colour story. This will save on ink usage.
- Make your carbon data and your actions part of your signage to communicate your efforts to your audience.

### Outdoor signage

- Make sure the materials you choose for your outdoor signage are weather resistant and UV stable. You do not want to continually replace it because the material is not suitable for being outside and fades in direct sunlight.
- Try avoiding materials that have a high carbon impact and search for ones that have a high recycled content.
- Avoid multi-layered materials or adding layers, such as vinyl graphics, unless it extends the life of the signage or allows for updating.
- If designing signage for permanent or long-term exhibitions, look for materials that can easily be cleaned.
- Look at the options for recycling leftover signage of previous exhibitions and reusing it in interesting and creative ways. Remember that the medium is also the message.
- Check if your signage can be attached to existing structures.
- If creating new structures for your signage try using temporary fixings, particularly for temporary signage.

### Infographic 13 TOTAL CARBON FOOTPRINT OF VISITS TO THE BIO26 WEBSITE

Unit: g CO<sub>2</sub>/page view



THIS IS EQUAL TO:

750km of travel by car

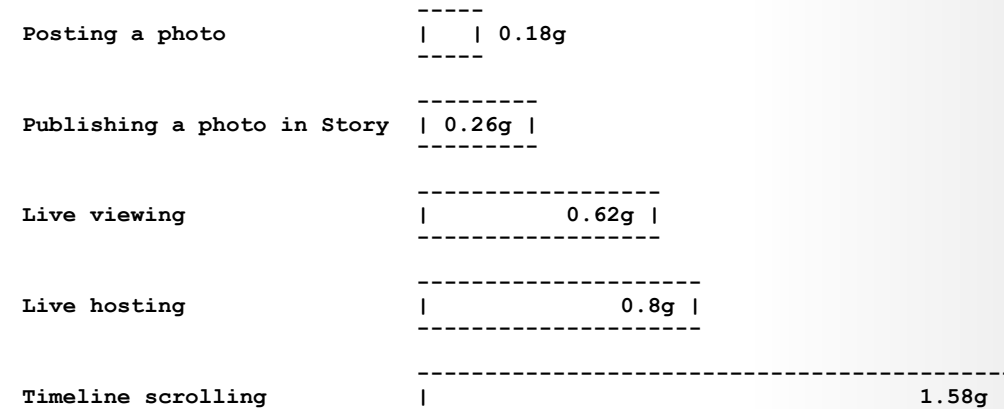
3400 sheets of photocopy paper

51 citylight posters

9 billboards

### Infographic 14 CARBON IMPACT OF INSTAGRAM FEATURES

Unit: g CO<sub>2</sub>



Source: Greenspector (Derudder 2020)

### Case Study 6 SOLAR-POWERED WEBSITE

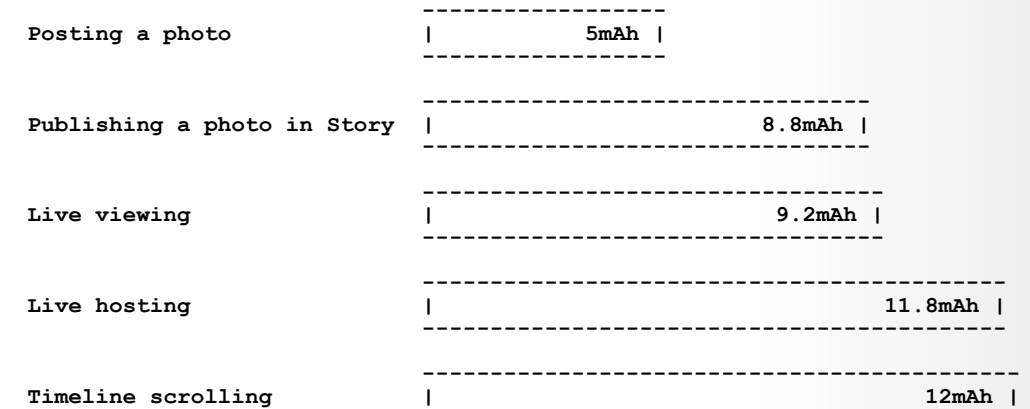
According to the latest estimates, the internet consumes 10% of global electricity production (McKenzie 2021), three times more energy than all wind and solar power sources worldwide can provide. With the average website producing 1.76 grams of CO<sub>2</sub> for every page view and data trafficking doubling roughly every two years, Low-tech Magazine, a magazine dedicated to questioning the belief in technological progress and highlighting the potential of past knowledge and societies for designing a sustainable society, has taken a radical stance. In an effort to reduce the energy consumption of the website, they opted for a back-to-basics web design, using a static site instead of a database-driven content-management system. They further applied default typefaces, dithered images, off-line reading options, and other tricks to lower energy use far below that of the average website. This resulted in a self-hosted, solar-powered website which needs 1 to 2.5 watts of power supplied by a small, off-grid solar PV system on the balcony of the author's home.



Low-tech Magazine, a solar-powered website.  
Source: <https://solar.lowtechmagazine.com>

### Infographic 15 ENERGY CONSUMPTION OF INSTAGRAM FEATURES

Unit: mAh



Source: Greenspector (Derudder 2020)

Especially when it comes to digital design, environmental measures might seem very creatively constraining. Video content, which has become the predominant medium of sharing information on social media since it engages viewers the most, also has the most significant environmental impact of all digital content, contributing 80% of energy consumption and its associated greenhouse emissions on the internet. However, as it is important to think of alternative ways to present information, it is also crucial to assess the importance of the message you want to spread, and if justified, use the most intriguing medium to do so. In other words, a completely reductionist approach to design would be, of course, absurd, yet keep in mind that sometimes, more restrictions might result in more innovative solutions.

The last chapter is divided into three main sections:

- Website <sup>[P29]</sup>
- Newsletter <sup>[P29]</sup>
- Social Media <sup>[P29]</sup>

#### 6.1 Website <sup>[IG13, CS6]</sup>

“In considering internet sustainability, the design of a website constitutes the majority of energy use” (Otsuka 2018). “An average website produces 1.75 g of CO<sub>2</sub> for every page view. The more complex a website is, the more energy it requires to load – and the greater its climate impact” (Chan 2021).

What to keep in mind:

- One of the most effective ways to reduce a website's carbon footprint is to switch to a green web host, essentially a hosting company whose operations are powered by renewable energy; e.g. GreenGeeks, Kualo, Runbox (Chan 2021).
- Static websites (a website that is generated once and exists as a simple set of documents on the server's hard disk), while less efficient in management, deliver stable content with every user seeing the exact same thing on each individual page (De Decker 2018). This streamlines information flow and processing power (Tomasz 2021).
- Reduce the amount of website-specific styling, such as custom typefaces, as it simply overrides browser defaults. Embracing defaults in your design avoids having to load more assets.
- Reduce the amount of images and graphical elements. When incorporating images consider implementing low-resolution previews or reduce their size through a technique called dithering. This is a technique “to create the illusion of ‘colour depth’ in images with a limited colour palette” (Wikipedia 2022).
- Think carefully before deciding to publish content in video format – is it possible to replace it with text and pictures?
- Avoid embedding autoplay videos on websites. Try to keep your videos as brief as possible (The Shift Project 2019).
- Consider implementing a dark mode option, to lower screen brightness and energy consumption.

#### 6.2 Newsletter

- Reduce the number and size of emails sent to your subscribers by condensing the information. Not only the environment – your subscribers will be grateful as well.
- Reduce the amount and lower the resolution of embedded graphics and pictures.
- When possible, provide links to websites and shared file storage instead of sending attachments.

#### 6.3 Social Media <sup>[IG14, IG15]</sup>

Rather than a newsletter, consider social media as your main channel of communication with your audience. Large platforms, such as Facebook and consequently Instagram, have already made a move towards carbon neutrality (Hern 2021).



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